TRANSFORMING THE CONDUCT OF NAVAL STRIKE FIGHTER OPERATIONAL TEST AND EVALUATION

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Transformation

by

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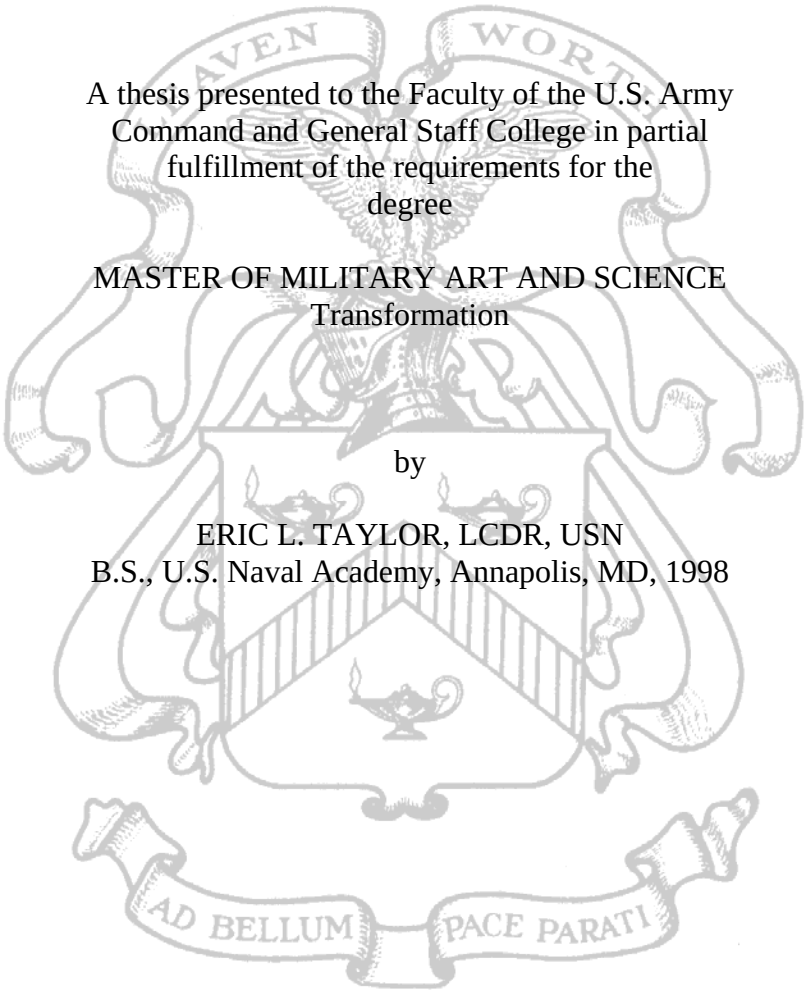

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Acquisition reform has been a continual process for the past 230 years. Today's reforms continue that trend. In the era of reducing budgets and increasing acquisition cost, a solution must be found to reform the current structure. The Department of Defense has initiated such reform goals in its transformation initiatives. However, these solutions are still running into the problems of previous reform efforts.

The acquisition system is enormous and any attempt to fix the entire system is beyond the scope of this paper. This paper will focus more on a micro level, in particular the relationship between the Developmental Test and Evaluation (DT&E) and Operational Test and Evaluation (OT&E) squadrons located at Naval Air Weapons Station (NAWS) China Lake, California.

The relationship between DT&E and OT&E is strained, causing problems in cost, schedule, and communication. Additionally, personnel staffing and an antiquated test structure creates problems which reduce efficiency. The differing goals and priorities of the institutions involved accompanied with the separate command structures creates this friction. These differences will be addressed in detail. The solution presented and analyzed in this paper proposes combining these two squadrons into one squadron.

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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

TRANSFORMING THE CONDUCT OF NAVAL STRIKE FIGHTER OPERATIONAL TEST AND EVALUATION, by Lieutenant Commander Eric L. Taylor, United States Navy, 89 pages.

Acquisition reform has been a continual process for the past 230 years. Today's reforms continue that trend. In the era of reducing budgets and increasing acquisition cost, a solution must be found to reform the current structure. The Department of Defense has initiated such reform goals in its transformation initiatives. However, these solutions are still running into the problems of previous reform efforts.

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The relationship between DT&E and OT&E is strained, causing problems in cost, schedule, and communication. Additionally, personnel staffing and an antiquated test structure creates problems which reduce efficiency. The differing goals and priorities of the institutions involved accompanied with the separate command structures creates this friction. These differences will be addressed in detail. The solution presented and analyzed in this paper proposes combining these two squadrons into one squadron.

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ACRONYMS

AESA	Active Electronically Scanned Array
AFI	Air Force Instruction
AFSO21	Air Force Smart Operations for the 21st Century
AIRPAC	Commander Naval Air Forces Pacific
AVDLR	Aviation Depot Level Repairable
CAPT	Captain
CD	Critical Design
CDR	Commander
CNO	Chief of Naval Operations
CO	Commanding Officer
COI	Critical Operational Issue
COL	Colonel
COMNAVAIRPAC	Commander Naval Air Forces Pacific
COMOPTEVFOR	Commander Operational Test and Evaluation Force
COTF	Commander Operational Test and Evaluation Force
CTP	Chief Test Pilot
CWO	Chief Warrant Officer
DA	Developing Agency
DAU	Defense Acquisition University
DAWIA	Defense Acquisition Workforce Improvement Act
DoD	Department of Defense
DoDD	Department of Defense Document

DoDI	Department of Defense Instruction
DOT&E	Director Operational Test and Evaluation
DRR	Design Readiness Review
DT	Developmental Test
DT&E	Developmental Test and Evaluation
EOA	Early Operational Assessment
FASA	Federal Acquisition Streamlining Act
FOT&E	Follow On Test and Evaluation
FRP	Full Rate Production
FY	Fiscal Year
GDP	Gross Domestic Product
HOL	Higher Order Language
IOT&E	Initial Operational Test and Evaluation
IPT	Integrated Product Team
IT&E	Integrated Test and Evaluation
ITEA	International Test and Evaluation Association
JDAM	Joint Direct Attack Munition
JHMCS	Joint Helmet Mounted Cueing System
JMPS	Joint Mission Planning System
JSF	Joint Strike Fighter
JSOW	Joint Stand-Off Weapon
JT&E	Joint Test and Evaluation
LCDR	Lieutenant Commander

LFT&E	Live Fire Test and Evaluation
LRIP	Low Rate Initial Production
LTCOL	Lieutenant Colonel
MS	Milestone
NAS	Naval Air Station
NAVAIR	Naval Air Systems Command
NAWC	Naval Air Warfare Center
NAWCWD	Naval Air Warfare Center Weapons Division
NAWS	Naval Air Weapons Station
NDIA	National Defense Industrial Association
NOTS	Naval Ordnance Test Station
NWC	Naval Weapons Center
OA	Operational Assessment
OMB	Office of Management and Budget
OT	Operational Test
OTD	Operational Test Director
OT&E	Operational Test and Evaluation
OTRR	Operational Test Readiness Review
RBA	Revolution in Business Affairs
RDML	Rear Admiral (Lower Half)
RDT&E	Research, Development, Test and Evaluation
RIE	Rapid Improvement Event
RMA	Revolution in Military Affairs

SCS	Software Configuration Set
T&E	Test and Evaluation
TOPGUN	United States Navy Fighter Weapons School
U.S.	United States
USAF	United States Air Force
USAFTPS	United States Air Force Test Pilot School
USC	United States Code
USMC	United States Marine Corps
USN	United States Navy
USNTPS	United States Navy Test Pilot School
VADM	Vice Admiral
VFA	Strike Fighter Squadron
VX-4	Air Development Squadron FOUR
VX-5	Air Development Squadron FIVE
VX-9	Air Test and Evaluation Squadron NINE
VX-31	Air Test and Evaluation Squadron THREE ONE
WCMD	Wind Corrected Munitions Dispenser
WSEP	Weapons Separation
WSO	Weapons System Officer
XO	Executive Officer

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CHAPTER 1

INTRODUCTION

Introduction

Acquisition reform has been a continual process ever since the first item was purchased by a government agency. With the birth of the United States in the latter half of the 18th century came the need for a new government to procure items and goods. Before long, the new government enacted laws to define how and what goods to acquire. With these laws came the birth of the U.S. acquisition system. Since then laws and regulations have been added on a continual basis crafting the modern day acquisition system. Yet as time passed, the system has morphed itself into a monstrous bureaucratic process while cries for reform echo constantly through the streets and buildings of the nation's capital.[1] It is likely that these cries of reform can also trace their roots back to the first laws enacted to regulate government acquisition.

Acquisition reform has taken on the guise of a never ending series of legislative efforts and changes in the way of doing business. Reform itself has almost become a business. The modern era of acquisition reform began with the processes that resulted from the Vietnam War acquisition programs. Since then a continual scrutiny has been placed on how the Department of Defense (DoD) acquires new systems. While various administrations and policies have come and gone since Vietnam, the one constant has been acquisition reform. Figure 1 outlines a brief synopsis of the reform initiatives taken over the past 50 years. It by no means encompasses the entire reform effort but provides a general idea on the size and complexity associated with acquisition reform.

Year	Regulation or Initiative Published
1969	Packard Initiatives
1971	Blue Ribbon Defense Panel (Fitzhugh Commission)
1972	DoDD 5000.1 (Major System Acquisitions); Commission on Government Procurement
1973	DoDD 5000.4 (CAIG); DoDD 5000.3 (T&E)
1975	DoDI 5000.2 (Major System Acquisitions); DoDD 5000.28 (DTC)
1976	OMB Circular A-109
1978	Defense Science Board Acquisition Cycle Task Force
1979	Defense Resource Management Study
1981	Carlucci Initiatives; Defense Acquisition Improvement Program
1982	Nunn-McCurdy (thresholds)
1983	Grace Commission
1985	DoD 5000.43 (streamlining)
1986	Packard Commission
1987	DoDD 5134.1 (USD(A); DoDD 5000.49 (DAB)
1989	Defense Management Review
1991	Revised DoDI 5000.2 (Major System Acquisitions)
1994	Federal Acquisition Streamlining Act (FASA)
1995	Federal Acquisition Improvement Act (FASA II)

Figure 1. Defense Acquisition Reform Initiatives to 1995

Source: Christensen, David S. Ph.D., CAPT David A. Searle USAF, and Dr. Caisse Vickery. "The Impact of the Packard Commission's Recommendations on Reducing Cost Overruns in Major Defense Acquisition Programs." *Acquisition Review Quarterly.* (Summer 1999): 253.

Congress regulates everything in the acquisition system with the laws it enacts and the budgets it passes. The acquisition system reflects the government and political system in which it exists. Originally instituted as a system of checks and balances, the various branches of government hamper efficiency and reform.[2] However, the power Congress wields is a necessary one. While the regulations and bureaucracy placed on the

acquisition system are burdensome, they do provide some attempt to improve the system. Getting new changes enacted into law through Congress have proven to be difficult, yet some changes can be made within the confines of the current laws that do not require Congressional action.

The defense acquisition system is a behemoth. People spend lifetimes learning the inner workings of the system and never seem to understand the systems' inner workings. The number of reforms alone suggest an enormity all its own. Some have succeeded in a small way while others have failed. The intent of this paper is to suggest another possible reform of a smaller element in the acquisition community. Specifically this paper will focus on the relationship between the Developmental Test and Evaluation (DT&E) and Operational Test and Evaluation (OT&E) communities. United States Code Title 10 2399 (2007) draws a clear distinction between the two types of test organizations. DT&E tests systems and subsystems against engineering and contract specifications, whereas OT&E tests the end product of the programs against mission requirements. Historically these two entities have been separated throughout the acquisition process. While there have been attempts to draw these two closer together in recent years, the relationship is still distant, causing friction and duplication of effort resulting in increased cost and time to deployment for new weapons systems and capabilities. While this separation is mainly driven by law, some changes can be made within the current structure to improve efficiency and reduce cost.

The reduction of program cost is an absolute necessity in modern acquisition. The length of time programs spend in the acquisition pipeline directly affects the cost of the overall system. The average length of time it has taken for an aircraft program to move

through the acquisition process to deployment can take a decade or more. Additionally, by the time most of the systems are subsequently fielded the original requirements are outdated and the final product lags significantly in current technologies. Any reductions to the time it takes to deploy these systems will result in cost savings to the government. Time reduction is absolutely necessary as the cost of new weapons systems continue an upward spiral. The increase in cost, coupled with the reduction or redirection in government funding for the DoD, necessitates a reformation of the system.

The primary consumers of money in any company or program are the people and the bureaucracies involved with maintaining the entity. In these situations cost savings can be achieved through the reduction of people and bureaucracy. The DT&E and OT&E entities each grew up separate of one another and have their own reporting chains of command. While the separation of command is intentional, the redundancies involved in each entity can be eliminated. Doing so would require reorganization of both communities.

Accomplishing this reorganization appears to be the key to improving the system. Attempts have been made in the past by industry and government. Some have succeeded in reducing cost and schedule, while others have utterly failed. This paper will focus on one possible solution to the problem at hand through combining the two separate test squadrons into one test squadron conducting two missions. A way to accomplish this goal will be laid out in an attempt to better align to the realities of cost and schedule in the current testing environment.

Problem Defined

What cannot be stated enough is the sheer size and enormity of the defense acquisition system. Even at the lowest levels of the acquisition process the complexity of bureaucracy is mind boggling. Colleen A. Preston, the former Deputy Undersecretary of Defense for Acquisition Reform, outlines the problem well. She states:

> "The DoD acquisition system is a web of laws, regulations, and policies adopted for laudable reasons over many years. The intent of the system was to ensure standardized treatment of contractors; prevent fraud, waste, and abuse; ensure that the government acquisition process was fair; check the government's authority and its demand on suppliers; and, enhance socioeconomic objectives. While the intent of these provisions is laudable, combined, the result is a cumbersome system which takes too long to satisfy customer requirements. In addition, the system places administrative burdens on both DoD and our suppliers that adds cost to the product procured. We can no longer afford these costs and meet mission requirements within current fiscal constraints."[3]

Primary Research Question

The primary research question of this study is: how can the relationship between developmental and operational aircraft testing be changed to better align to the realities of cost and schedule in the current testing environment?

Subordinate Research Questions

The following questions will assist in framing the research and help in determining a workable solution to the current problems.

1. What is the current test structure?
2. What are the problems associated with the current test structure?
3. What reforms have been made to improve the acquisition process?

4. What obstructions have these reforms encountered?
5. What effect have these reforms had on resolving the problems associated with the current test structure?
6. What changes can be made to eliminate these problems?

Significance

Over the past twenty years costs associated with acquiring weapons systems have sky rocketed (Figure 2). During this same period, the time to deploy these weapons systems to the end user has also grown tremendously. Former Secretary of Defense Donald H. Rumsfeld, in his first key speech on transformation, pointed out that "it takes today twice as long as it did in 1975 to produce a new weapon system, at a time when new generations of technology are churned out every 18 to 24 months."[4] Due to more pressing funding issues and decreasing budgets, ways must be found to reverse these trends. If not it will become increasingly more difficult to acquire the weapons systems required to maintain a technological advantage over our enemies on the battlefield.

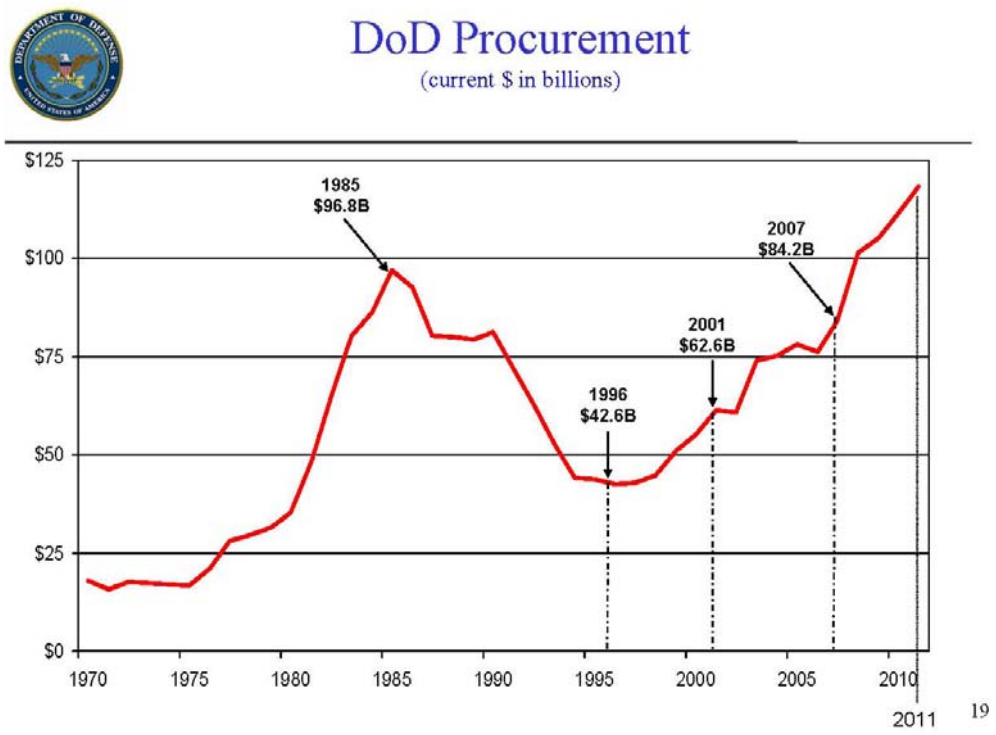

Figure 2. DoD Procurement Cost History

Source: U.S. Department of Defense. "FY 2007 Department of Defense Budget." Office of the Secretary of Defense. http://www.defenselink.mil/dodcmsshare/briefingslide/16/060206-D-6570C-001.pdf (accessed 17 March 2008): 20.

Assumptions

Primarily this study assumes that there is a need to change the current system. The sheer number of acquisition reform initiatives suggests such a need. Without recognition of the problem, no progress can be made in finding a solution.

Limitations

This paper will focus on testing naval fixed wing strike fighter aircraft and the software and weapons systems that are associated with them. Particular emphasis will be on the relationship between developmental and operational tests in the area of software and weapons systems testing. Aeromechanical developmental testing will not be discussed in full detail as the operational test relationships are not as important. Currently the Navy has a separate squadron that conducts all aeromechanical developmental flight testing of strike fighter aircraft. Aeromechanical testing expands the envelope in which the aircraft operates and therefore is not repeated during the operational test phase.

Summary

This chapter briefly described the complexity of the acquisition reform efforts and the problem as related to the scope of this study. The following chapters will further detail the problems associated with the current structure of the U.S. Navy's developmental and operational test community relationships and a proposed solution to the problems identified.

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[1] U.S. Department of Defense. *Defense Acquisition Transformation Report to Congress*. Office of the Secretary of Defense, Washington D.C.: Government Printing Office, February 2007: 2.

[2] Frank, Dr Deborah F. "A Theoretical Consideration of Acquisition Reform." *Acquisition Review Quarterly.* (Summer 1997): 288.

[3] Preston, Colleen A. "Acquisition Reform: Making It A Reality." *Acquisition Review Quarterly.* (Winter 1994): 8.

[4] Rumsfeld, Donald H. *DoD Acquisition and Logistics Excellence Week Kickoff-Bureaucracy to Battlefield*. Remarks at the Pentagon. 10 September 2001. http://www.defenselink.mil/speeches/speech.aspx?speechid=430 (accessed 30 January 2008).

CHAPTER 2

LITERATURE REVIEW

Introduction

The complexity and enormity of the defense acquisition system, coupled with the numerous attempts at reforming the system have led to a vast body of literature available on the subject of acquisition reform. This study attempts to focus the reform effort on the relationship between the U.S. Navy's strike fighter developmental and operational test squadrons. Additionally, there was more emphasis placed on recent literature, within the last decade, in an attempt at making the study more relevant. Previous literature was reviewed, and where still relevant, included in this study.

The primary sources of literature reviewed for this study include the numerous articles in professional journals associated with the acquisition community. These journals provide the most up to date information available on the subject of acquisition reform. Additionally, the annual conference proceedings held by the professional societies were a vast source of knowledge and discussion. Numerous books have been written on the subject of acquisition reform but the constant changes made to the acquisition process in recent years make these works dated but they provided a good historical perspective on changes already made and their results. Lastly a review of various studies conducted by research companies and other graduate research rounded out the material available. The common theme throughout the literature review is there is a need to change the current system to make it more cost effective and more efficient. Additionally, a recurring theme of involving all parties in the acquisition process

throughout the entire life cycle of a product, from initial development to deployment and then disposal, was present.

Background

In order to fully understand the problems associated with the current structure, a brief discussion of the histories of the two squadrons involved and a discussion of the current acquisition structure is required.

Brief History of Air Test and Evaluation Squadron THREE ONE (VX-31)

VX-31 traces its origins back to the formation of China Lake itself. The Naval Ordnance Test Station (NOTS) was established 8 November 1943 by the Secretary of the Navy with a mission to have "a station having for its primary function the research, development and testing of weapons, and having the additional function of furnishing primary training in the use of such weapons."[1] Through the years this mission has remained roughly unchanged though the name of the institution varied from NOTS to the Naval Weapons Center (NWC) in 1967, then to the Naval Air Warfare Center Weapons Division (NAWCWD) on 22 January 1992. Throughout this time what would become VX-31 was the air test arm of these institutions and provided the means by which to test the weapons and systems developed.

On 8 May 1995 the Naval Weapons Test Squadron, China Lake was established as a separate entity from NAWCWD although the reporting chain of command remained the same. As part of a reorganization within the test community, the squadron was re-designated Air Test and Evaluation THREE ONE (VX-31) on 1 May 2002.[2] VX-31 ultimately reports through NAWCWD to the Naval Air Systems Command (NAVAIR) in

Patuxent River, Maryland. VX-31's current mission is to "provide the resources, expertise and support needed to plan and execute safe and efficient ground and flight test of developmental weapons and weapon systems … operate a cost effective and efficient flying test bed program to support the DoD RDT&E [Research, Development, Test, & Evaluation] community."[3] To accomplish this, VX-31 maintains 19 F/A-18 Hornet aircraft of varying models (A-G), along with other platforms associated with the Naval and Marine Corps aviation community. Supporting the mission there are 33 aircrew, 322 maintainers and support personnel, and over 2,000 engineers and contractors.[4]

Brief History of Air Test and Evaluation Squadron NINE (VX-9)

VX-9 traces its lineage back to Air Development Squadron FIVE (VX-5) which was established 18 June 1951. VX-5's mission was to "develop and evaluate aircraft tactics and techniques for delivery of airborne special weapons."[5] VX-5 moved to China Lake, California in 1956. Through the years VX-5 maintained detachments throughout the United States to evaluate systems in varying climates. In June 1993 the Chief of Naval Operations (CNO) directed that the efforts of VX-4 and VX-5 be combined into a single evaluation squadron as part of the "right sizing" of the force structure following the end of the Cold War. On 30 April 1994 Air Test and Evaluation Squadron NINE was established at China Lake, California.[6]

VX-9's current mission is to operate as a force to conduct an "independent and objective evaluation of the operational effectiveness and suitability" of all platforms and systems destined for use in the U.S. Navy and to develop tactical procedures for their employment.[7] As a part of this mission, VX-9 is assigned to report the results of operational evaluations conducted to Commander Operational Test and Evaluation Force

(COMOPTEVFOR or COTF). However, VX-9's administrative chain of command reports to Commander Naval Air Forces Pacific Fleet (COMNAVAIRPAC or AIRPAC). To accomplish this mission VX-9 has fifteen F/A-18 Hornet aircraft of varying models (A-F)[8] along with other platforms associated with the Naval and Marine Corps aviation community. There are 30 aircrew, over 200 maintainers and support personnel, and 33 engineers and contractors directly associated with VX-9 in support of the mission.[9]

Current Test Structure

The current structure of the defense acquisition system is defined by the Department of Defense (DoD) 5000 series documents. These documents spell out in detail how to run the defense acquisition system. To delve into detail is not required for the purposes of this paper. What is required is a general understanding of how testing is structured in relation to developmental and operational test. This basic knowledge will help when we compare options on how to reform the system.

The primary objective of defense acquisition is to "acquire quality products that satisfy user needs with measurable improvements to mission capability and operational support, in a timely manner, and at a fair and reasonable price."[10] The current defense acquisition management framework is shown in Figure 3.

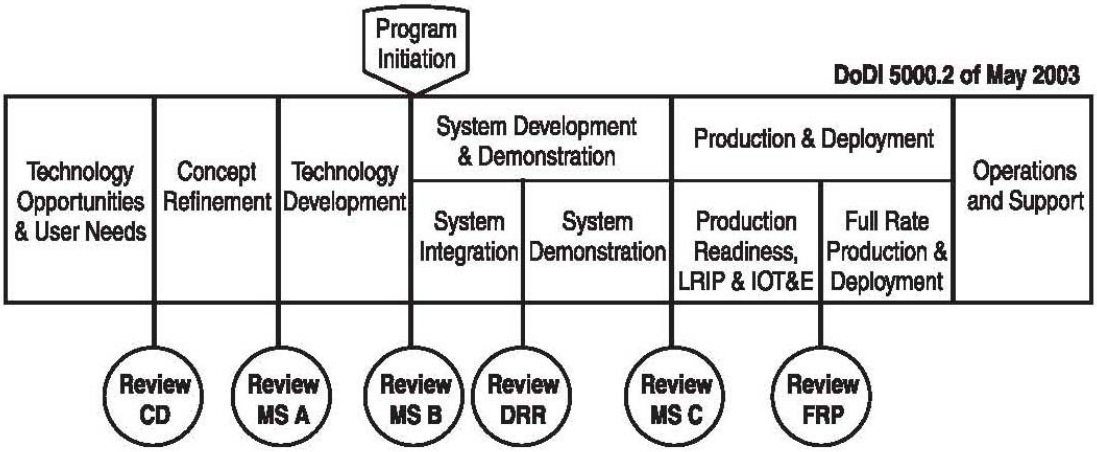

Figure 3. Defense Acquisition Management Framework

Source: Dillard, J.T., "Toward Centralized Control of Defense Acquisition Programs" *Defense Acquisition Review Journal*, Volume 12 No 3 (2005): 337.

This model is used by DoD in the acquisition of new programs. To better understand where the two communities fall within the framework, Figure 4 provides for a breakdown of the system into area competencies.

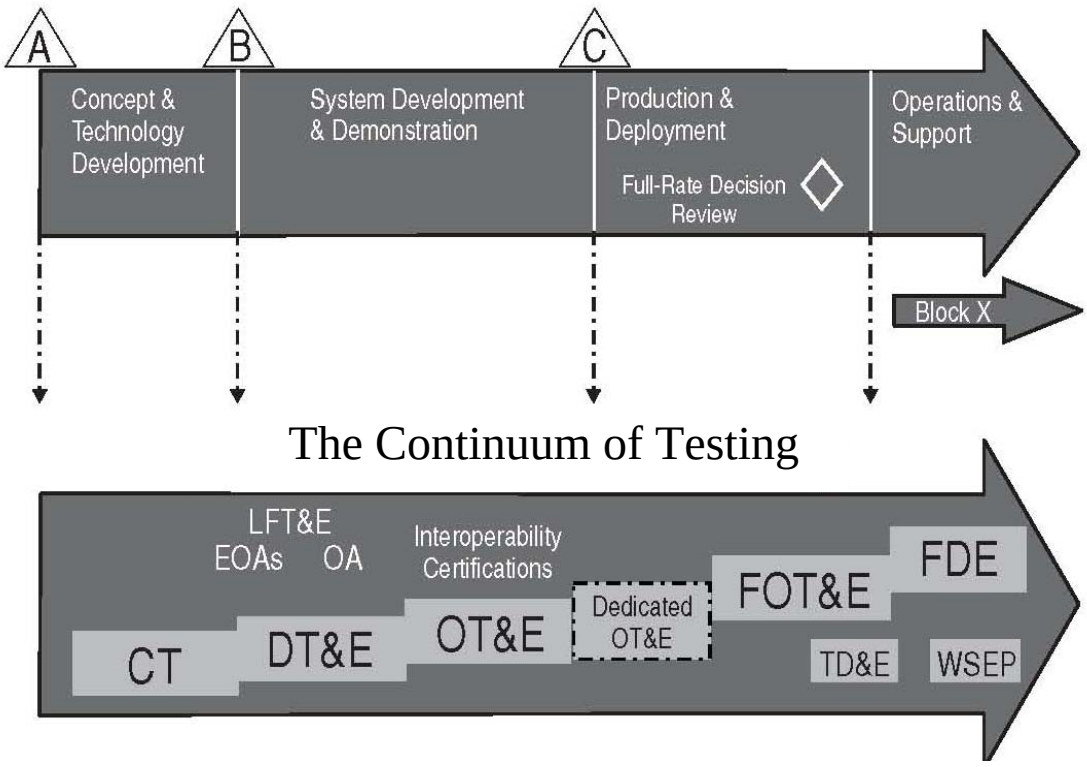

Figure 4. Defense Acquisition Process with Test and Evaluation Timelines

Source: Barnette, Gregory L. "Test and Evaluation in a Dynamic Acquisition Environment." *Defense Acquisition Review Journal.* Volume 37. (December - March. 2005): 338.

Ideally the primary areas where OT&E has input into the acquisition process is during the Early Operational Assessment (EOA), Operational Assessment (OA), and during the OT&E periods denoted. Other than those periods OT&E aircrew have been encouraged to participate in DT&E as observers. Communication between DT&E and OT&E is essential during these times as the developmental process is ongoing.

During the last decade acquisition reforms have shown a need for a different way to acquire new systems due to the costs associated with current programs. This need, coupled with the move from a “threat based” to a “requirements based” acquisition

strategy, due to the end of the Cold War, have driven the acquisition community and DoD to implement spiral development of systems. The spiral development model is found in Figure 5.

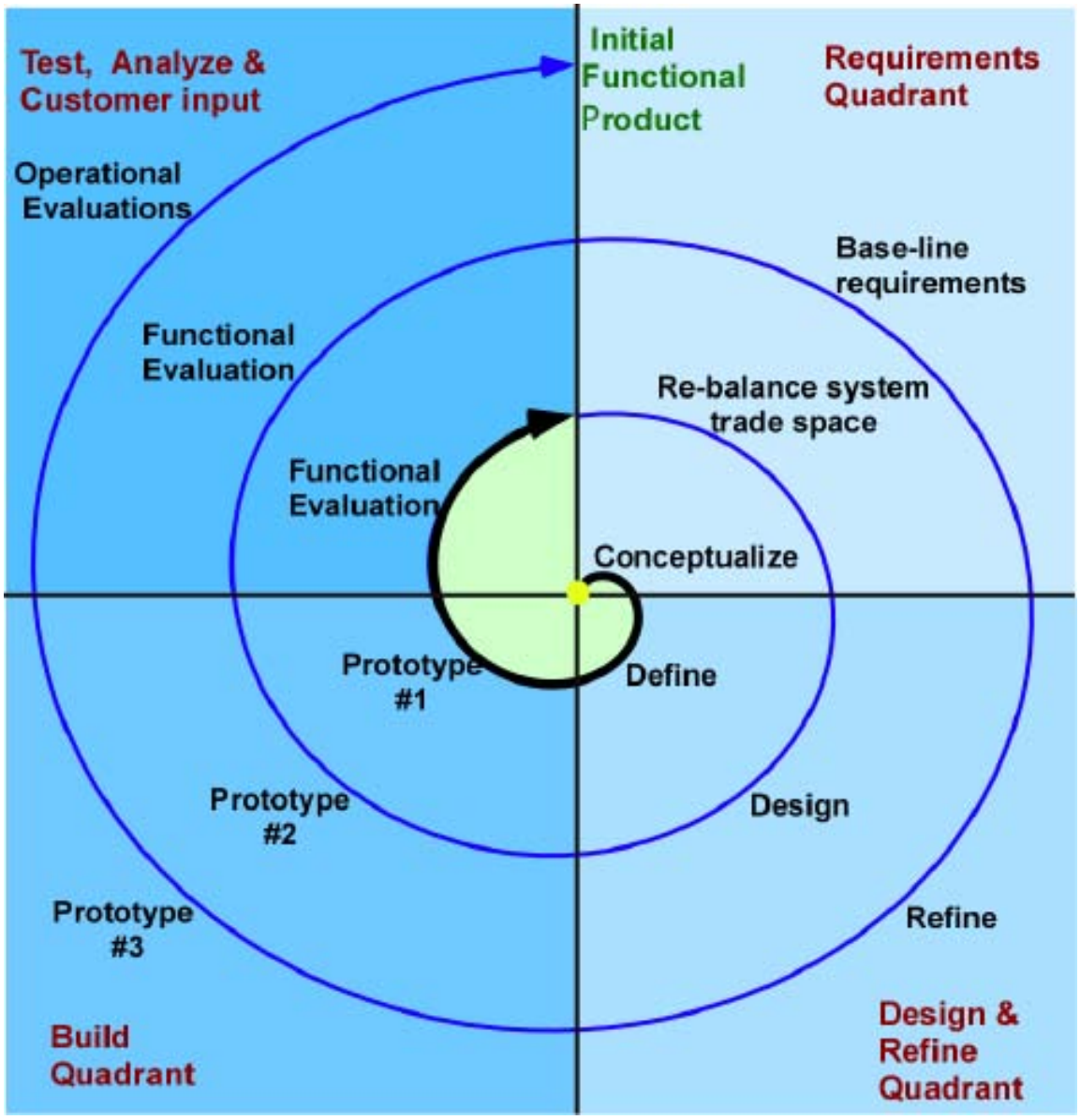

Figure 5. Spiral Development Model

Source: i3 Aerospace. "Providing Sustained Maritime Surveillance on a National Scale is a Tall Order." http://www.i3aerospace.com/strategy (accessed 13 June 2008).

Spiral development builds upon previous work and institutes new technologies once they become mature enough to add to a system. The reason to institute a spiral development structure is to help drive down costs and decrease the time to field new capabilities. While the effectiveness of these changes is yet to be determined, this is the current system construct this study will use when recommending changes.

Transformation

> "Transformation is a process and a mindset- not a product."- Gen Richard B Myers, USAF, Former Chairman Joint Chiefs of Staff[11]

Transformation has taken on many meanings over the years and specifically so in the acquisition world. Current acquisition reform is trying to model commercial industry and achieve the successes that U.S. businesses have had in the global marketplace through maximizing productivity. However, the reforms in government have failed to achieve the same successes as in industry leading to a continual parade of reforms.[12] Annually, new initiatives or directives are attempted within the acquisition community. Many fail before they ever fully get implemented. Others are a casualty of the cultural bias inherent in all organizations.

The players involved in transforming the acquisition system are as numerous as the initiatives that have been attempted at reforming the structure. The primary reasons many reforms have failed have been due to the sheer size of institutions and how many people the initiatives affect. Primarily the acquisition system is controlled by two major players, Congress and the Department of Defense. While only two main institutions control the acquisition process, the details in the relationship between the two entities is complicated. Laws enacted by Congress put numerous regulations on DoD as to how

acquisitions should be accomplished. These laws have created numerous departments within DoD that complicate the process. The Deputy Secretary of Defense for Acquisitions controls the procurement and test activity while the Director of Operational Test and Evaluation (DOT&E) controls oversight of the programs for operational purposes. These two coupled with numerous other agencies to monitor joint testing, joint acquisitions, and other aspects associated with the defense acquisition system provide for an enormous bureaucracy that is difficult to control or reform. Before we reform we must have a reason for reforming, and understand the impediments that can occur when attempting to change a large, bureaucratic system.

Why Reform?

Acquisition reform should make the system more efficient, improve business practices, and allow buying more with less.[13] Recall the public outrage in the late 1980's when the $400 hammer stories broke in the press.[14] The public was outraged at what appeared to be irresponsible spending and that alone remains a strong argument for reforming the acquisition system. Until 2002, DoD had conducted 128 studies on acquisition reform and identified a slow bureaucratic process as the main impediment to change.[15] This is the same problem that subsequent commissions indicate are still present within the acquisition community today.[16] This suggests that no reforms were seriously attempted by the organizations that were identified or that the initiatives attempted failed in their purpose. The failure further suggests an organizational culture resistant to change. This culture is manifested in the bureaucracy and status quo of the current system. The "we've never done it that way before" attitude is pervasive in the current system. In order for true change to occur within institutions, obstructions to change require recognition

and tailored efforts must be made to specifically target these cultural and institutional obstructions. Finally the motivation to change is lacking, simply because the current systems works however costly and inefficient.[17]

The greatest reasons for reform were spelled out recently in the International Test and Evaluation Association (ITEA) Journal article by Brian M. Simmons:

> "(1) The systems acquisition and associated T&E process has changed during wartime and is unlikely to return to the traditional process when the war is over; (2) Business transformation demands more efficiency in T&E processes now; and (3) Networked testing requires the testers to rely on each other as opposed to staying in traditional Service, local test range or developmental test (DT)/operational test (OT) domain."[18]

The OT&E community has realized these imperatives and has started to voice their concern. Thomas P. Christie, a former DOT&E, put it this way, "Either we change our way [OT&E] of doing business, adapt to the new acquisition paradigms and the war on terrorism, or we will find ourselves becoming irrelevant."[19]

Resistance to Change and Its Affect on Reform

> "The only people who like change are wet babies." - Sir Brian Wolfson[20]

No reformation process occurs easily. There are always obstacles to change. Critics of reform point to its past failings and political slant rather than become an agent for change.[21] The obstacles are generally the same. The greatest obstacles to change are the organizations themselves. No one likes learning to do new things. People become accustomed to how things are and change causes discomfort. If change is considered a threat to the organizational rule it is fought at all levels within the institution. The larger the organization, the more difficult it is to change. However, in order to remain

competitive, businesses will typically institute change when market forces dictate. In so doing they recognize areas needing change and institute those changes in a timely manner.[22] Why then is it so hard for the government to change its way of doing business? Specifically, why can the OT&E community not change to improve efficiency and reduce cost? Talking about why transformation objectives have failed in the past, Mr. Christie stated "We've [OT&E] never really taken [these reform efforts] to heart; granted, we ... continue to make changes to the process, but we have yet to really come to grips with some of the root causes."[23]

Change can and does work as evident in the business community. In order to achieve lasting change, institutional stove-pipes must be eliminated. Change must be driven by superiors. However, real cost savings and streamlining cannot be done at higher levels but must be accomplished only by the members of each participating agency.[24] The key is to remember transformation is not a place in time or the delivery of a capability. Rather, it is a commitment to sensible, event-driven, proactive change. It is a journey, not a destination.[25]

Cost & Schedule

During the mid 1980's, Norman Augustine wrote a humorous characterization of the cost growth of military aircraft. His Law XVI states:

> "In the year 2054, the entire defense budget will purchase just one aircraft. This aircraft will have to be shared by the Air Force and Navy 3-1/2 days each per week except for leap year, when it will be made available to the Marines for the extra day."[26]

While this may be humorous, the growth of weapons system cost seems to lead to this eventuality. Cost and schedule drive every major acquisition program. Decisions that are made are usually done solely on these two principles. Figure 6 and Figure 7 show the aircraft program trends over the past 50 years.

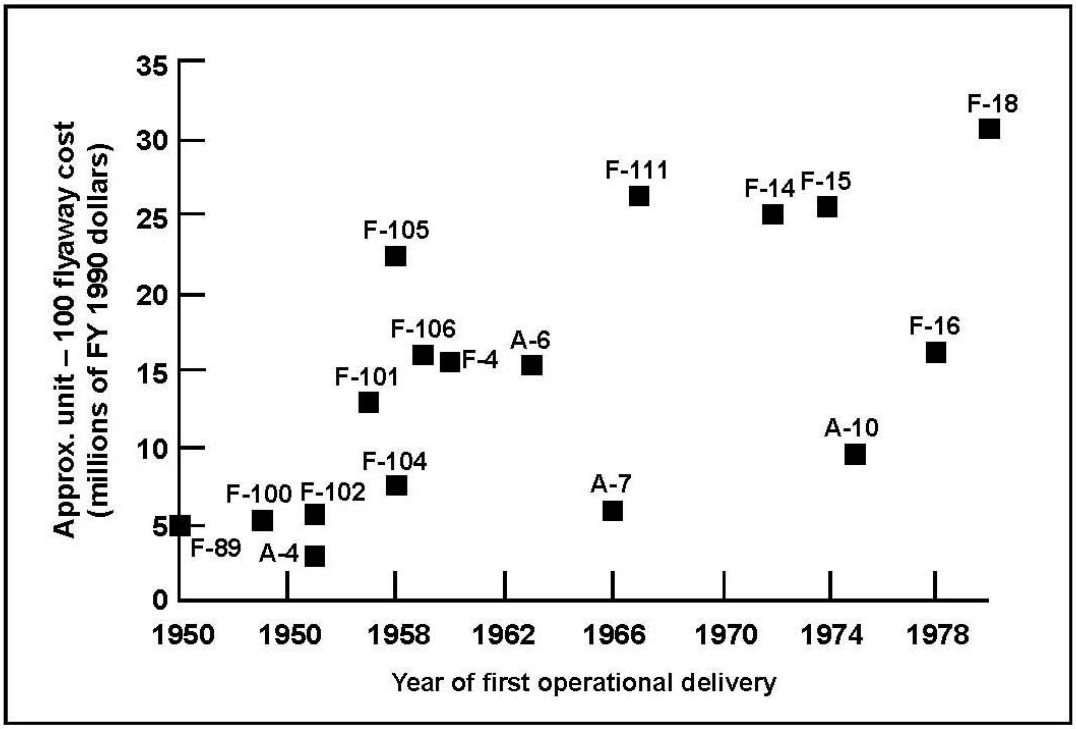

Figure 6. Aircraft Program Cost

Source: Eskew, Dr. Henry L. "Aircraft Cost Growth and Development Program Length: Some Augustinian Propositions Revisited." *Acquisition Review Quarterly.* (Summer 2000): 211.

Aircraft cost over the period analyzed by Figure 6 grew at an inflation adjusted rate of 3% per year.[27] This is of modest growth. However, the complex systems in the

acquisition process today (F-22, V-22, and Joint Strike Fighter aircraft), coupled with the probability of decreased buys will likely drive this growth rate substantially higher.

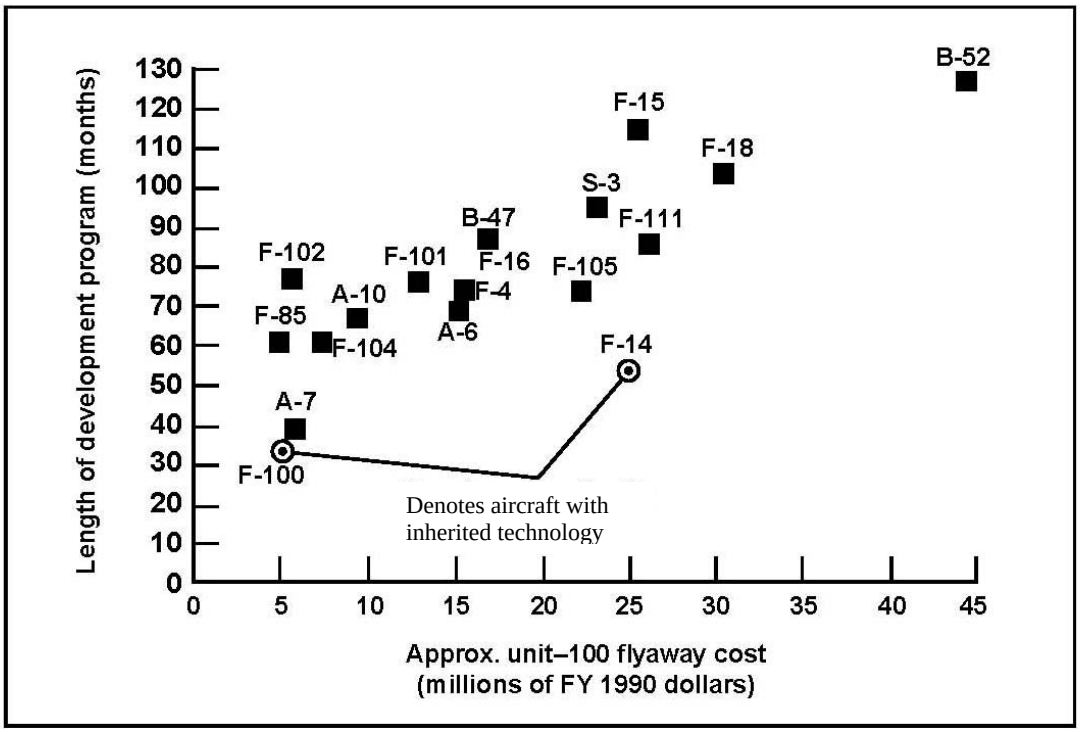

Figure 7. Aircraft Development Program Length

Source: Eskew, Dr. Henry L. "Aircraft Cost Growth and Development Program Length: Some Augustinian Propositions Revisited." *Acquisition Review Quarterly.* (Summer 2000): 215.

While seemingly independent of one another, the two variables of cost and schedule are intertwined and constitute the majority of the problems faced with any program development. Figure 7 shows that as program length increases so does cost. It is estimated that a two month increase in program length roughly equates to $1 million in 1990 adjusted cost.[28] Over the past 20 years, the time to deploy new weapons systems or

capabilities has increased dramatically. Any reduction in the time to deploy these systems directly relates to a decrease in cost for the overall program. In acquisition, time is money.

Department of Defense funding has been in decline throughout much of the past 20 years. Figure 8 shows the historical relationship and trend of the DoD budget since the end of World War II. The general trend is expected to continue to decline.[29]

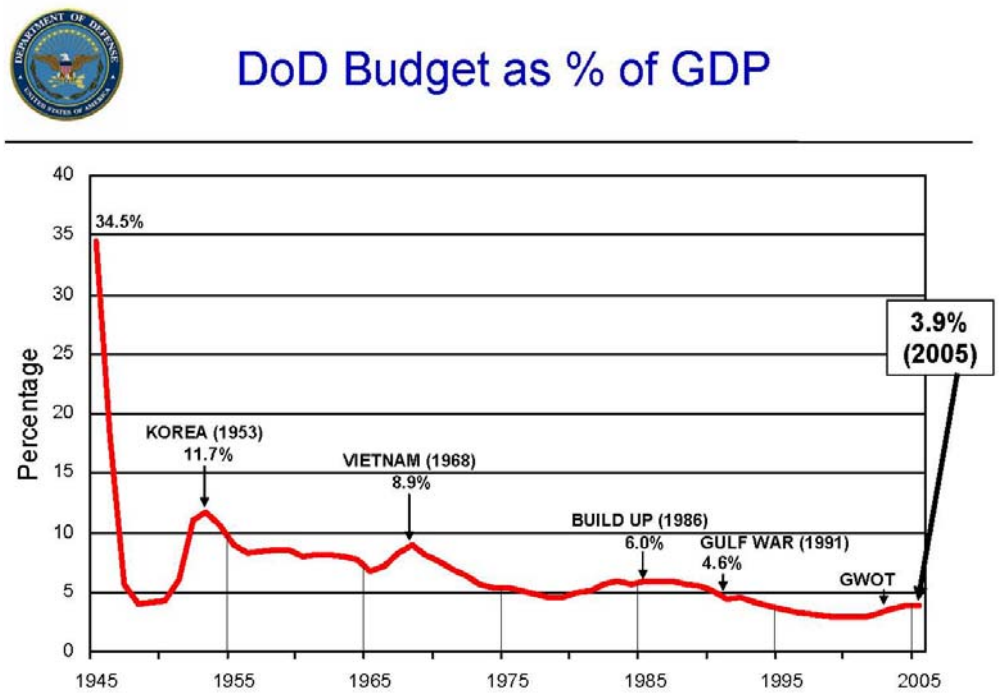

Figure 8. Defense Budget as a Percent of GDP

Source: U.S. Department of Defense. "FY 2007 Department of Defense Budget." Office of the Secretary of Defense. http://www.defenselink.mil/dodcmsshare/briefingslide/16/060206-D-6570C-001.pdf (accessed 17 March 2008): 26.

The budgets associated with acquisitions of new systems and updates to existing systems have mirrored this decline (Figure 9). Coupled with the decline in funding is the increase in costs associated with acquiring new state-of-the-art equipment (see Figure 2). The two funding crunches have often meant reduction of testing to save money. The realities of reduced budgets and increasing costs do not appear to be reversing anytime soon. Therefore, solutions must be implemented by industry and government to reduce cost and increase efficiencies during the acquisition life cycle.

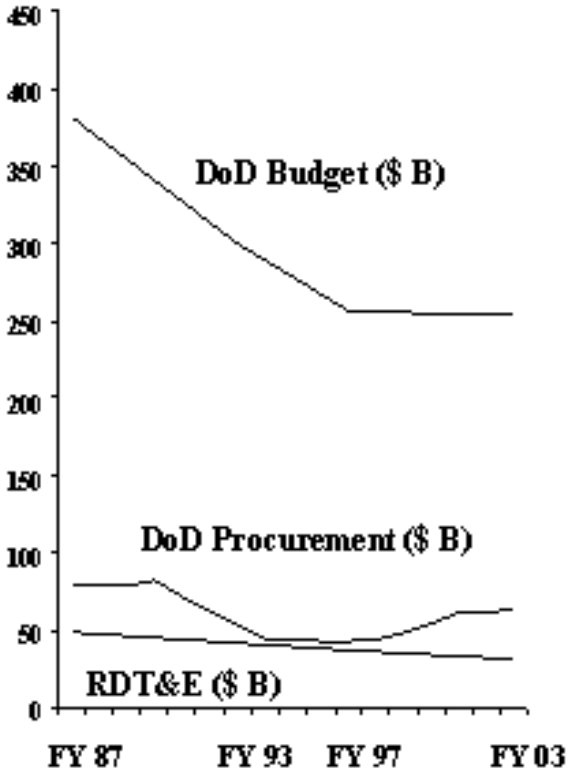

Figure 9. DoD Budget Trends

Source: U.S. Department of Defense. *FY 1997 Annual Report*. Director Operational Test & Evaluation. Washington D.C.: Government Printing Office, 1997.

Cost and schedule have been the target of nearly every major acquisition reform initiative over the past 50 years. The Global War on Terrorism has increased demand for newer and better systems or capabilities. The customer wants and needs these systems quickly which increases the potential of circumventing a rigorous and lengthy acquisition process.[30] Any solution that would enable controlling cost and schedule or minimizing the impact to programs would greatly enhance the test community.

Communication

Communication between the DT&E and OT&E squadrons at China Lake is dysfunctional. A recent 2007 survey conducted by the National Defense Industrial Association (NDIA) showed that a majority of their 2007 national convention participants thought the relationship between the DT&E and OT&E communities was "strained, conflicting, minimal, sometimes non-existent, somewhat hostile."[31] The lack of communication results in three very serious problems; no OT early involvement, redundancy in testing, and operational evaluators not familiar with the systems they are evaluating. The absence of communication stems from the inherent structure of the two squadrons which have no common chain of command. VX-9 answers to COTF in Norfolk, Virginia, while VX-31 is a subsidiary of Naval Air Systems Command (NAVAIR) in Patuxent River, Maryland. Often any program communication between VX-9 and VX-31, located physically 200 yards apart, must be routed through entities residing on the east coast thousands of miles away. Due to this, communication between DT&E and OT&E is usually delayed weeks at a time as official messages must get written for formal communication.

The failure of communications is not just a problem at China Lake but rather a systemic problem of the structure of the two organizations. In testimony to Congress on the V-22 program, Program Manager Colonel Nolan Schmidt, USMC, stated the "lack of effective communications ... was an outgrowth of deliberately separate test and program office structures." He further charged that "contact between OPEVAL and the program office is a deviation from the norm."[32] The delays and current structure are unnecessary and an enormous barrier to communication.

Personnel Management

Personnel associated with the acquisition system are another potential problem area. People are huge consumers of money in any business, and the acquisition community is no exception. In testimony before the House National Security Committee the then Director of Test, Systems Engineering & Evaluation Dr Patricia Sanders stated:

> "It is clear that the bulk of our money is spent on manpower-at least 54% for government personnel and an additional 15% for contractor services…if a reinvention idea does not reduce required manpower, it will not have a significant impact."[33]

Recent reform initiatives have attempted to address the staffing concerns within the acquisition community. Figure 10 shows the reduction in acquisition staffing as a result of the reform initiatives.

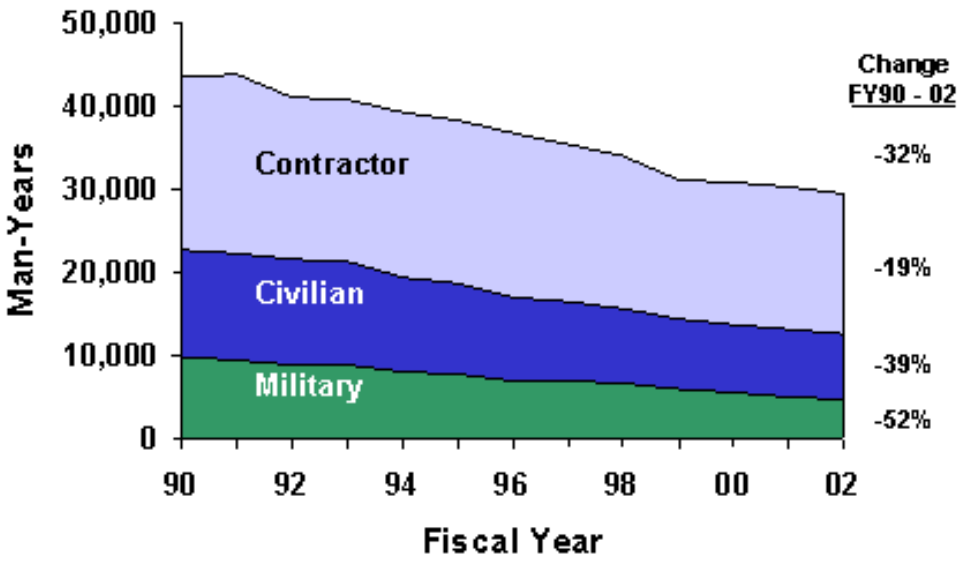

Figure 10. Acquisition Workforce Staffing Levels

Source: U.S. Department of Defense. *FY 2001 Annual Report*. Director Operational Test & Evaluation. Washington D.C.: Government Printing Office, 2001.

The reduction in staffing is seen as an attempt at reducing the duplication of effort within the current structure. Personnel management was a primary transformation initiative of Secretary Rumsfeld as he saw the need to ask tough questions on redundant staffs. Slashing duplication would make decisions move quicker and encourage more cooperation.[34] While these cuts have gone far, greater efficiencies could be made. Additionally the Navy is already having difficulties fully staffing both squadrons with the personnel "required" to get the job done. Currently, aircrew staffing at VX-9 is at 74%[35] and VX-31 is at 63%[36] of the required levels. Both squadrons have been operating at a reduced level for years and the job is still getting done. Therefore, efficiencies could be made in the area of personnel management.

Test Structure

The test structure associated with the two squadrons is decades old. While there have been some changes made to the structure, no meaningful benefit has resulted from these changes. What is needed is a comprehensive review of how to accomplish testing in today's acquisition environment. The Revolution in Military Affairs (RMA) that has evolved over the past decade must be accompanied with a Revolution in Business Affairs (RBA) to fully transform the acquisition system.[37] New mindsets and ways of thinking must be generated throughout the acquisition system in order to make any real reforms successful.

Paths Toward Change

The path towards integrating DT&E and OT&E has been a gradual progression since the 1960's. Each subsequent acquisition reform or attempt to save money in the T&E process enacts new ideas on how to move DT&E and OT&E closer together. The newest of these ideas have been the processes of Integrated Test and Evaluation (IT&E) and Joint Test and Evaluation (JT&E). Both of these processes have attempted to improve the current structure for the same reasons mentioned here, but have failed due to the same problems mentioned also.

Two programs currently operating at China Lake offer a view of these initiatives, but for separate reasons. The two programs are the current testing being conducted on the EA-18G Growler and the AV-8B Harrier programs.

EA-18G Growler

The EA-18G Growler program is a testament to the IT&E process. Integrated Product Teams (IPT) enhance communication between the Navy and the contractor. Additionally, OT&E has been brought into the IPT's and have worked side by side with DT&E personnel. Both aircrew conduct developmental and operational testing and results are shared across the spectrum. This structure has enabled the program to achieve improved results in cost and schedule performance. However, the Growler has yet to enter the OT&E phase of testing where this interaction should pay off enormously. The success of the program remains to be seen. To be fully successful this interaction must continue until the last Growler is in service, not until the first one reaches the Fleet which is how it normally occurs.

AV-8B Harrier

The AV-8B Harrier program is nearing the end of its life cycle. By 2015 the Harrier will be replaced with the new Joint Strike Fighter (JSF). The example set by the Harrier program is not so much the interaction of the aircrews but rather the structure of the maintenance force. Since airframes are becoming scarce and resources have diminished, the Harrier program was integrated in 2007 into VX-31's maintenance department. The testing structure still remains the same but now all aircraft are assigned to VX-31. This maintenance structure could be a key component on how to integrate the two squadrons. Any future analysis must look at lessons learned from this integration.

Air Force Programs

The Air Force has recognized the need to reform its processes as well. In 2004 the Air Force combined their old manuals *Developmental Test and Evaluation* (AFI 99-101), *Operational Test and Evaluation* (AFI 99-102), and *Live Fire Test and Evaluation* (AFI 99-105) into one comprehensive manual, *Capabilities Based Test and Evaluation* (AFI 99-103). This effort was undertaken to foster "an integrated testing philosophy in an effort to streamline Test and Evaluation."[38] AFI 99-103 espouses an integrated test approach and seeks to employ combined DT&E and OT&E whenever practical. This integration will eliminate duplicate testing, correct schedule deficiencies, and identify program concerns early in the process, much sooner than would be done under the traditional systems. The end result will be a better product, developed efficiently and delivered more quickly to the Fleet.

Recently the Air Force has called for more changes in their DT&E and OT&E relations. In September of 2006 the Air Force held a Rapid Improvement Event (RIE) as part of the service's Air Force Smart Operations for the 21st Century (AFSO21) program. The RIE was titled "Early Tester Involvement" and discussed ways in which early involvement could reduce overall weapons system cost. One of the conclusions from this conference was the need for "integrated developmental testing/operational testing."[39]

In all the Air Force has found success in their attempts at transformation. They are closer to succeeding where others have failed. Acquisition reform does work. The Air Force saved $20 billion on their reform initiative at the turn of the century.[40] Continued reforms offer even greater savings. Hopefully instituting the solutions mentioned here will enable the Navy to start seeing results similar to these.

Summary

Chapter Two has laid the foundation of knowledge needed to understand the historical background of the organizations and players involved, a basic understanding of the current acquisition structure, the problems associated with that current structure, and some programs that have begun to reform the current system. This basis of knowledge will be used in the following chapters to further analyze ways to fix the problems of cost, schedule, communication, personnel management, and test conduct.

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CHAPTER 3

RESEARCH METHODOLOGY

This research analyzes the current relationship between the U.S. Navy's developmental and operational test squadrons located at NAWC China Lake, California. In the previous chapters the historical setting, current structure, and problems were detailed. Chapter Three will explain the methods used to gather the data presented in the following chapters.

The research conducted was a comparison of the available literature written on the subject. No statistical or mathematical methods were used. In addition to available literature, interviews were conducted with members of the two squadrons along with reporting data for those squadrons. Once the research was completed the data was compiled for comparison in this study.

The first step in conducting the research was to determine the historical relationship between the two squadrons. Through researching squadron histories the individual squadron relationships were easily determined. However, the historical interaction between these squadrons could not be determined, but was inferred through the literature reviewed. The historical relationship also included research into the congressional laws governing the current system. Understanding the limit of these laws is essential to determining solutions to any problems and the path that must be taken to correct deficiencies. Lastly, a historical review was conducted of the acquisition reform initiatives undertaken in the past 50 years. The focus of this research was on what was attempted, what worked, what failed, and why.

After determining the historical background, research was conducted on the current structure of the acquisition process. Understanding the current acquisition process is fundamental to finding problems and solutions.

Once the current acquisition process was thoroughly reviewed, research focused on where the problem areas were. This research consisted of problems identified through the literature review as well as problems identified through interviews and personal experience working on numerous acquisition programs. Results were then grouped into categories for further analysis.

The final step in the research was to examine the problems identified and provide a possible solution as to how the system could be improved. The analysis used for the formulation of the proposed solution was a compilation of current programs that have been used recently and the next logical step in the progression that had been seen in the research. First the options available to reform were examined. From the options, criteria noted from the research of communication, cost, schedule, and personnel were used to formulate the best option to proceed forward with. This option was then vetted in detail using the same criteria. Then a way to accomplish a test using the new system was examined for clarity.

This study is intended to offer a path forward to solve the current problems. It provides a possible solution and a starting point for further analysis.

CHAPTER 4

ANALYSIS

Introduction

The previous chapters have outlined the historical setting and have described in depth the issues associated with the relationship between the developmental and operational test communities. Understanding this relationship, to include the factors of cost, schedule, communication, personnel management, and the conduct of testing is critical to developing any solution.

The literature review (Chapter Two) examined five of the six subordinate questions listed in Chapter One. This chapter will consider the final question: What changes can be made to eliminate these problems?

Available Options for Change

There are fundamentally three solutions available to transform the conduct of testing strike fighter aircraft within the U.S. Navy. These solutions are: do nothing and try to work within the current system, eliminate the operational test squadron, or combine the two squadrons into a single entity to perform both missions. These options will be evaluated against the main criteria noted in this study of cost, schedule, communication, and personnel.

Maintain the Current Structure

The first option of doing nothing is basically the route the Navy has taken in past reform efforts. Attempting to work within the current system construct leaves little room

for improvement. Any improvements implemented may produce minimal results because the underlying problems still remain.

Cost and schedule reductions are listed as one of the major factors affecting the current T&E structure.[1] Most reforms attempted to date have been at trying to achieve results within these two areas. However, progress implementing prior solutions to problems has been limited.[2] Without a drastic change in how the system is structured or how testing is performed, there is only a maximum amount of improvement to be gained in the current structure. Additionally, the decision cycle time required to deliver products to the Fleet user has been reduced beyond the ability of the current system to function effectively.[3]

Communication under the current structure would require significant improvement from its current state. The stove-pipe mindset of organizations was another challenge facing the T&E community.[4] Figure 11 shows the current organizational relationship between the DT&E and OT&E communities within DoD.

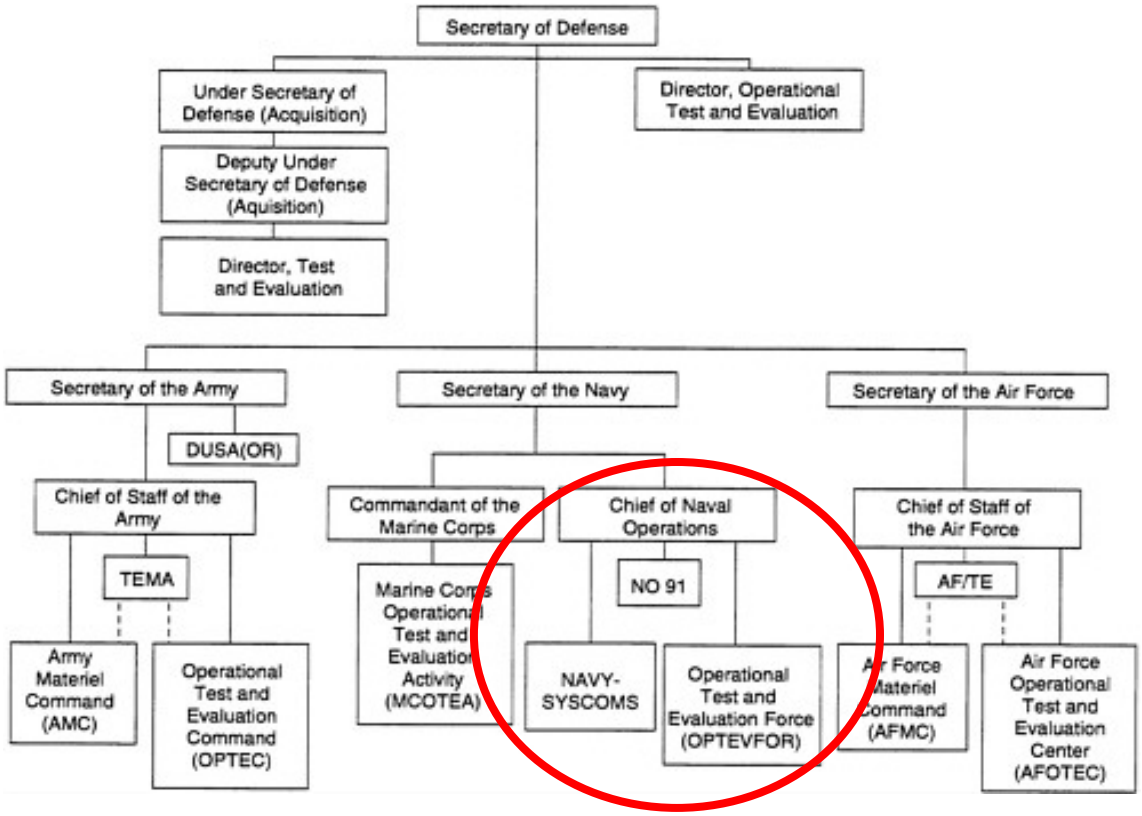

Figure 11. DoD T&E Organizational Chart

Source: National Research Council. *Statistical Methods for Testing and Evaluating Defense Systems: Interim Report.* Washington D.C.: National Academy Press, 1995. 75.

Highlighted in Figure 11, the lowest level of official coordination between DT&E and OT&E within the Navy is located at the service chief level. The lack of a defined relationship below this level leads to numerous problems within the current system. Attempts at improving communication within this structure have lead to integrated test efforts that have attempted to combine contractor test (CT), with DT&E and OT&E. Even with these advances, efforts were still stove-piped.[5] Within these stove-pipes exist distrust,[6] competing requirements, and enormous bureaucracy[7] that effect a multitude of areas within the current structure.

Staffing levels will be difficult to affect with no change to the current structure. While there may be small improvements in increasing efficiency and eliminating redundancy, no significant change can be made to affect progress in acquisition reform.

The Navy cannot afford to continue to do business as usual and more drastic measures are required to realize any cost savings or efficiencies to the current structure. The current T&E model is questionable in a transformational environment for the reasons shown.[8] Due to these problems maintaining the current structure is not a viable option.

Eliminate OT&E

The reduction in cost and schedule that could be achieved through the elimination of OT&E would be minimal to the overall program cost and schedule.[9] Where the savings would be found is in the overhead associated with the OT&E squadron and personnel assigned. There would also not be a communication problem as there would be no requirement to communicate with an entity that does not exist.

Eliminating the operational test squadron initially sounds like the best option, and the one with the greatest cost savings. However, in order to achieve these cost savings some tradeoffs will have to be made. There are fundamental differences in how and what DT&E and OT&E test. Figure 12 shows the testing differences between the two communities.

How Tests are Conducted	
DT&E testing is properly conducted: • In a controlled environment that minimizes the chance that unknown or unmeasured variables will affect system performance • By technical personnel skilled at "tweaking" to maximize performance • Against simulated threats tailored to demonstrate various aspects of specified system technical performance	OT&E testing is properly conducted: • In an operationally realistic environment (e.g., high seas, temperature extremes, high density electromagnetic environments) under conditions simulating combat stress and peacetime conditions • With Fleet operators and maintenance personnel • Against threats which replicate, as closely as possible, the spectrum of operational characters • Using Fleet tactics
Testing Subject/Topic	
DT&E tests a weapon or a "blackbox," whatever the development program involves. (Seldom does a development program involve a complete weapon system.)	OT&E tests total weapon systems. If a missile is being developed, OT&E does not test only the missile itself, but rather the missile system, which includes the firing platform; that platform's detection, classification, and targeting systems; the people who man it; logistical support; interfacing equipment; etc.
Evaluation Criteria	
DT&E – Technical criteria are parameters measured during controlled DT&E tests.	OT&E – Operational criteria are the CNO-provided minimum acceptable operational performance requirements (older programs) or measures of effectiveness/suitability (newer programs), or thresholds, which quantify the Critical Operational Issues (COI).
Measurement and Frequency	
DT&E • The DA generally knows what he/she wants to measure (some particular parameter: launch velocity; the number of g's pulled as the missile acquires; time to climb; etc.). • DT&E tests are structured to hold many things constant, isolate others, and allow measurement of one or two parameters of interest. • It is generally possible to verify data statistically through replication of tests.	OT&E • It is often not possible to specify measurements. • The objective is often simply to create combat conditions as closely as possible and record data as events unfold. • For aviation OT&E, with highly time-compressed test events and a high cost for OT&E, it is mandatory that OTDs know exactly what parameters of their system must be examined to resolve the specified COI. • OT&E cannot enjoy the luxury of isolating a variable. Methods of data capture must be devised during operational evolutions or during postoperation analysis. • It is often not possible to replicate data because interactions during tests are unique.

Figure 12. DT&E and OT&E Test Comparison

Source: Commander, Operational Test & Evaluation Force. "Operational Test Directors Manual." *COMOPTEVFORINST 3980.1*. Norfolk, Virginia. April 2008: 2-6, 2-7.

Eliminating testing requires a balanced approach with risk. How much risk is the government willing to accept with a given system. There is never enough time or money to achieve absolute certainty in testing so a balanced risk assessment must be made.[10] Eliminating duplicate testing poses little risk. Additionally, with the reduced decision cycle time, the ability of the operational tester to provide timely, value-added information in the current structure has been removed.[11] Yet this must be balanced with what tests would not be performed, and what criteria systems would be evaluated against.

Research has shown that operational test is needed and provides a different perspective on system performance. The picture of the overall system is invaluable in providing a quality product to the end user. Additionally, operational test is mandated by Congress[12], so eliminating the operational test squadron cannot be easily accomplished. The downsides to eliminating OT&E far outweigh any benefits. Therefore, eliminating OT&E is not a viable option.

Combine DT&E and OT&E

The final option is to combine the developmental and operational test squadrons. Numerous studies have put forth this option as solving the major ills within the acquisition community. A 2005 COMOPTEVFOR report conducted under guidance from the Chief of Naval Operations (CNO) concluded:

> "The use of combined DT/OT has been identified as one of the most prevalent and successful 'innovative' approaches to the planning and conduct of T&E … [and] integrated test should be viewed as an order of magnitude increase in collaboration over what occurs currently in combined DT/OT."[13]

DoD continues to move toward this path of integration. As recently as December 2007, DOT&E Dr Charles McQueary stated in a memorandum "developmental and operational test activities shall be integrated and seamless throughout the system life cycle."[14] The best way to do this is to combine the squadrons. The following discusses the merits of this option and one solution on implementing this change.

Proposed Solution

Prior to putting forth any solution, the players involved must be identified since they will affect any solution developed. As stated previously Congress wields enormous power within the defense acquisition system. The laws enacted drive the framework of the DoD 5000 series documents. Both Congress and the DoD, including the various sub agencies that encompass the acquisition community and the operational test community, will have tremendous power in determining if the final proposed solution will work.

The proposed solution to the problems defined earlier and numerous other issues associated with the relationship between DT&E and OT&E is to combine the two squadrons into a single test entity under a single chain of command. The goal of combining the two squadrons would be to reduce overhead, improve management, eliminate duplication, and tighten control to minimize cost growth and schedule slippage.[15]

The question of combining T&E assets and structures is not a new one. Usually the talk is of a single DoD T&E organization. This paper will not take it to that level, but instead will suggest a single Navy T&E structure. The pursuit of greater cost effectiveness and efficiency leads to this course of action.[16] During his confirmation hearing before Congress, current Secretary of Defense Robert M. Gates outlined as one

of his key tenets the need to "balance the acquisition and operational testing processes between reducing costs and accelerating schedules."[17] While this solution may not be what he had in mind, it certainly addresses his required outcome.

The biggest speed bump on the road to true joint testing lies between the DT&E and OT&E communities.[18] The focus of the remainder of the discussion will be on how to combine the two squadrons, what the new structure will look like, and analyze the efficiencies gained through the new relationship. Finally, a simulated test conduct will be discussed to better understand how to implement this new process. It must be understood that change is neither easy nor comfortable for those involved. The drastic changes that have occurred in the modern military environment over the past decade must be accompanied with drastic action to fix the problems inherent in the system.

Implementation

There are numerous ways in which to combine the DT&E and OT&E squadrons into one efficient organization; the solution discussed here is only one of them. An idea for the structure and makeup of the proposed organization will be developed and expanded in order to validate the concept.

Structure

Due to the size and organizational structure currently in place, the basis for the combined squadron will be the current VX-31 organization. Additionally, the DT&E process is inherently more flexible as requirements are generated internal to the program and can quickly adapt to changes in a spiral development process. By integrating OT&E

into this same structure, OT&E can become more flexible as well. For the purposes of this study all VX-9 assets will be considered for integration into VX-31.

The first major hurdle with integration is the role of the operational evaluators as an independent and objective "agency." Since the changes proposed do not affect COMOPTEVFOR or the office of DOT&E, the independent "agency" still exists. What will have to be included in any combined squadron is a way to gather and report evaluation results and still maintain an independent status. Additionally, by going this route the requirement to have Congressional law changed has been removed as long as it can be shown that any results from evaluations are independent and objective. However, this is a source of debate but most state that DoD has the authority under Title 10 USC.[19]

The focus of discussion will be on adding elements to the current structure at VX-31. These elements are direct transfers associated with the closing of VX-9 and the consolidation of assets. Not all assets will have to be transferred as will be shown in the course of discussion. The true cost savings associated with this reorganization is the elimination of overhead associated with running a separate squadron and the reduction in the number of aircraft, aircrew, and maintainers required to conduct the operational evaluation mission.

VX-31 already contains a robust administrative structure on conducting developmental test and evaluation. In order to assume the new operational test role, minor additions will have to be made to the administrative structure. In addition to the already established Commanding Officer (CO), Chief Test Pilot (CTP), and Executive Officer (XO), a position of Operational Test Director (OTD) will have to be added. This billet will be a commander/lieutenant colonel position. The CO will have overall

responsibility for the integrated squadron. The CTP will assume responsibility for the developmental testing while the OTD will be responsible for the operational testing. The role of the OTD will be to run all operational evaluations to be conducted and be the administrative conduit to COTF.

Aircrew will be integrated into the new structure as well, although at a reduced number. The reduced number will be due to the reduction of aircraft to be assigned and a complete change in how operational test is to be conducted. Table 1 shows the current staffing levels of both squadrons with a representative Fleet F/A-18F squadron included.

Table 1. Squadron Staffing Comparisons

Squadron	Pilots	Weapons System Officers (WSO's)	Other Officers	Enlisted
VX-9[20]	23	8	8	~250
VX-31[21]	15	7	3	322
Fleet F/A-18F[22]	17	18	5	194

Source: Created by author. Information extracted from squadron documents.

The integrated squadron would have a new core of 10-15 operational evaluators, down from over 30 aircrew previously in VX-9. They will integrate into the current project structure and work directly with the developmental test pilots on day to day project functions. The day to day involvement should help facilitate early involvement and the insight gained from being involved from the beginning of a program should reduce the scope of the follow-on dedicated OT&E and contribute to reduced life cycle time and cost.[23] Training of the new aircrew will also be a factor which will be discussed later.

The maintenance departments will undergo a similar, but much more dramatic restructuring. Table 1 also shows the representative maintenance staffing of the squadrons involved and a representative Fleet squadron. A core problem when integrating the two maintenance departments is that currently VX-9 has military maintainers, while VX-31 has recently moved to a contract maintenance force with military oversight. As part of the operational evaluation on new systems, maintenance practices must also be evaluated under conditions similar to Fleet maintenance. Because of this requirement a purely contract maintenance force is not a viable option. However, a smaller military maintenance section could be established within VX-31's current structure to evaluate maintenance practices when the need arose.

To accompany the integration of the aircrew and maintenance, aircraft assets will have to be integrated. Table 2 shows the current aircraft totals for all Hornet types currently assigned to each squadron.

Table 2. Current Squadron Aircraft Allocation

Squadron	F/A-18C	F/A-18D	F/A-18E	F/A-18F	EA-18G
VX-9[24]	1	2	5	7	N/A
VX-31[25]	3	2	3	9	2
Fleet F/A-18F	-	-	-	12	-

Source: Created by author. Information extracted from squadron documents.

To effectively accomplish most tasks in an integrated squadron will take the addition of approximately six aircraft. These aircraft would have to meet the test requirements VX-9 aircraft currently meet as they must be in a Fleet representative configuration. These

aircraft would be maintained by the combined contractor/military maintenance of the new squadron. When operational evaluations occur, a team of military maintainers will execute the evaluation. The existing maintenance personnel would have to be increased to accommodate the addition of the aircraft. An increase of ten maintainers of various ratings would be required for each aircraft added at a cost of $85,000 per man year.[26] Effectively this combination alone would reduce the current VX-9 force of aircrew, maintainers, and aircraft down to 15, 60, and six respectively. This equates to a reduction of 52%, 76%, and 60% in each category. In maintenance personnel alone the savings would be over 16.2 million dollars per year.

The current staff of VX-9 contractors and engineers would remain unchanged. However, their role in the new structure would differ dramatically. The personnel would have to be integrated into the test teams already established on the developmental side and provide input to the developmental team on operational issues and concerns. They would also have to step up their test preparation work in order to meet the new requirements associated with how the bulk of operational evaluations would be conducted under this construct.

Training

Training for aircrew and engineers is extremely important in understanding and running a test in the acquisition community. Well trained test personnel are required to accomplish test programs efficiently.[27] Today this training is rather one-sided as only the developmental test community has a well defined training program. All aircrew from both DT&E and OT&E have a similar basis of experience prior to their assignments in these two communities, having served three to four years in an active Fleet squadron.

After this initial shared experience the paths for training diverge. The DT&E aircrew and some engineers attend an 11-month detailed instruction at a U.S. or foreign test pilot school in the planning, conduct, and execution of tests. This instruction also includes classes on the makeup of the acquisition structure along with Congressional and DoD requirements of the acquisition system. By contrast no such equivalent exists for OT&E aircrew. Operational evaluator aircrew may attend a three day course of instruction at COTF[28] but this requirement is often bypassed. Instruction is mainly on reporting requirements and structure of the organization. Once both developmental and operational aircrew finish their respective instruction both aircrew have the requirements of the Defense Acquisition Workforce Improvement Act (DAWIA) to maintain. DAWIA requires continued study in the field of acquisition tailored to a primary subspecialty area. This training is offered online and at resident classes via the Defense Acquisition University (DAU). The requirements for all aircrew are the same and based on rank. In an integrated squadron a better training regimen must be established.

This study does not suggest that everyone should be trained to be a rated test pilot. However, it is recommended that a new course of instruction be offered at the US Navy Test Pilot School (USNTPS) similar to the one offered at the US Air Force Test Pilot School (USAFTPS). USAFTPS offers a two week course of instruction at their school which is given specifically for operational evaluators.[29] USNTPS already offers "short courses" to members of the acquisition community which last from one to a few weeks on varying topics of instruction. USNTPS should take the program currently offered at COTF and integrate it into a "short course." This operational evaluation "short course" could also have elements implemented into the core curriculum of the test pilot

instruction program to enhance all aircrew learning. The new “short course” would be a requirement for any aircrew that have not completed the longer test pilot course of instruction. An added benefit of relocating the operational evaluation training to USNTPS would be the combining of DT&E and OT&E training at a single location .

So what does that leave in numbers? For the theoretical staffing of 15 operational evaluation aircrew the recommendation would be that five to eight of those be test pilot school graduates to help in the conduct and execution of tests. Additionally this would open up more flight opportunities to these aircrew as they would have the required training to execute some of the more demanding tests. An additional three to five aircrew would be U.S. Navy Fighter Weapons School (TOPGUN) graduates. The remaining aircrew would be direct from operational Fleet tours. Therefore both the TOPGUN and Fleet aircrew would be candidates for the USNTPS “short course” along with any contractors or engineers.

Conduct of Test

The addition of aircraft and aircrew would greatly enhance the ability of the developmental test team to more efficiently use instrumented test aircraft and allow for early involvement of operational evaluators in the early stages of testing. Early involvement is a key tenet of operational evaluation. The longer a program progresses down the acquisition life cycle, the cost and time to fix any problems found increase exponentially. Decisions made in the first 10 to 15 percent of the work done on a program usually drive the program costs.[30] OT&E has a good track record over the past decade of getting involved early in major test programs of new equipment. A primary example of this success is the EA-18G Growler program, where DT&E and OT&E

aircrew work side by side on a near daily basis to conduct both developmental and operational testing and evaluations. Yet after the new equipment has been fielded and the novelty of working on a new program wears off, OT&E early involvement in programs becomes nearly non-existent. However, due to the DoD's preferred acquisition process of spiral development, this leaves major upgrades to systems with no OT&E early involvement. For many programs the first OT&E interaction is at the Operational Test Readiness Review (OTRR) which is far too late in any program to make major decisions should problems occur. Charles McQueary, DOT&E, states "Developmental testing is the place to find problems. Operational testing should be a period of confirmation, not a period of discovery."[31] In order to do this OT&E must be involved early and continuously.

The integrated concept will require some major changes in how operational evaluations would be conducted. Traditionally after OTRR, the testing phase would be transferred to VX-9 and they would conduct the operational evaluation. Since the size of the operational force of the integrated squadron has been greatly reduced this is no longer a viable option. A new way to conduct the operational evaluation must be used. A major finding by the 2005 COMOPTEVFOR report was to "explore the opportunities presented by the conduct of testing during fleet training and dedicated fleet experimentation events."[32]

Traditionally, Fleet squadrons returning from deployment enter a period of reduced operational tempo after their return, prior to beginning training for the next deployment cycle. During this down time flights are still conducted at a reduced pace. Typically towards the end of the reduced schedule time, the squadron schedules a

detachment to a location away from home station to get back into the training cycle. These detachments usually are to places like Key West, Florida and Hawaii. Normally these areas have sufficient training ranges and adversary squadron support. If adversaries are not available on site then arrangements are normally made to coordinate a detachment with another squadron to swap adversary support. These returning squadrons offer a unique opportunity to conduct the operational evaluation. Who is better qualified in current Fleet operations and tactics than those squadrons returning from deployment? This may sound like a novel idea but it is not new. VX-9 has used a similar policy to conduct operational evaluations before when they were unable to complete the mission themselves. The most recent example was the Software Configuration Set (SCS) 20X testing done by VFA-15 in Oceana, Virginia. In this case a "trusted agent" agreement was given to the Fleet squadron for testing and VX-9 and TOPGUN sent liaisons to VFA-15 to help in the conduct of the evaluation.

While this example offers a glimpse at how operational evaluations would be done in the integrated squadron, some things must change in how the SCS 20X evaluation was conducted. Historically the "trusted agent" status for testing only allows the given squadron to fly with the new equipment during the test phase. This is also a problem associated with testing at VX-9 as well. The longer and more often a particular test item is flown, the greater the chance of uncovering, and then fixing, a problem. The example of a returning squadron from deployment will form the basis of the analysis. The returning squadron could be given a new software load prior to their return to home station. During the transit back from theater is an ideal time to conduct orientation training on the items to be evaluated since all squadron members are present and there is

ample time. Aircrew from the test squadron could be sent aboard to conduct the training for both the pilots and maintenance personnel. All available documentation and points of contact would be delivered so the squadron could become familiar with the items under evaluation. Upon return to home station the item under evaluation (new software, a new avionics box, or other item) would arrive. The aircrew would then begin flying with the items as soon as practical so they can increase their familiarization with the system.

During the familiarization period aircrew support would be provided from the test squadron to enhance the learning process. This would typically give a one to two month window prior to the full evaluation for aircrew to get familiar with the system and its differences. This in-depth knowledge of system function will pay enormous dividends in testing. Once the official evaluation period begins, the Fleet squadron would be joined by members from the test squadron and TOPGUN to help conduct the evaluation. The evaluation would be run by the operational flight test engineers for data gathering and reporting. After the evaluation is complete the squadron should be allowed to continue flying the items (where practical) instead of making them revert back to older variants until the item is subsequently released to the entire Fleet. In all, this would give approximately six months of extra flight time on the systems under evaluation.

Since current OT&E aircrew require no specialized training in flight test, the Fleet aircrew would likewise not require any training other than system familiarization. During the operational evaluation, aircrew and engineers from the integrated test squadron would be planning and executing the test, flying with the Fleet aircrew, gathering test data, and submitting the evaluation report to COTF. Some test points may require more experienced aircrew, but nothing the Fleet squadron could not provide.

The cost associated with conducting the operational evaluation would be taken from program funding as it would normally have if the evaluation were done under the current system. The advantage of combining this effort with a Fleet squadron is that the Fleet squadron would have completed a detachment anyway and funding would have been taken out of their squadron operational funds for training. The detachment still accomplishes the training requirements of the squadron and saves the Navy money by not having to fund additional detachments.

The coordination of schedules would require some effort. Every year three to four Carrier Air Wings complete the training and deployment cycle. Each Air Wing would have four Hornet squadrons of varying makeup to accomplish testing. Therefore, roughly every three months there would be an opportunity to participate in a flight test. This schedule may slide by a few months either direction but the opportunities to match Fleet schedules to program schedules are available.

While this takes care of the majority of the evaluation, the integrated squadrons' operational side must conduct some testing prior to readiness for the Fleet evaluation. The only change to current procedure required here would be when the operationally configured aircraft fly with the new systems. Historically a system must be in its "final" configuration before it is loaded into the operationally configured aircraft. While this is good in principle, it may not be relative in real life. Due to spiral development the configuration is never set as final until released to the Fleet. Again this mindset limits exposure time for uncovering possible problems.

Supporting Agencies

This improved conduct of test will greatly enhance efficiency and communication between the two entities and produce a better product overall for the Fleet. However it does not address some other issues that surface due to the elimination of VX-9. Operational evaluation is not the only mission VX-9 conducts. The mission of developing new tactics is one which is very important to the use of the new systems. Recent history has shown there has been a lag in the deployment of new systems and the tactics of using them. While it may not seem so at first, the elimination of VX-9 might help resolve this problem.

TOPGUN is the purveyor of tactics to the naval aviation Fleet. The work they conduct and the products they produce form the back bone of the way naval aviation operates. However, their limited resources have meant they could not develop tactics until after Fleet introduction and Fleet systems started rotating through the TOPGUN classes. This leaves gaps in training and employment of the new systems. Primary examples of this in recent history have been the development of roles and responsibilities for aircrew piloting the F/A-18F two-seat aircraft, and the tactics for operating the Active Electronically Scanned Array (AESA) radar. While the Navy aggressively deploys the new AESA equipped aircraft, tactics still have not been fully developed.

The elimination of VX-9 frees up both aircraft and aircrew for assignment elsewhere. In order to accomplish the mission of tactics development the best fit for these aircraft would be as assigned to TOPGUN. These aircraft could be loaded with the same systems currently under test that have matured to the point where they would have previously been released for OT&E flight. This would address any safety and

airworthiness issues and enable their use for development of operational tactics. Another benefit to this would be additional sorties and flight time on the software in an operational environment to discover any errors or improvements. The addition of more TOPGUN trained personnel at the integrated squadron would help liaise with members at TOPGUN. The communication that exists currently between former and current TOPGUN members is extraordinary. Now TOPGUN trained personnel will be integrated into the test processes early, which will pay huge dividends for new and existing programs under development. In order to get the most out of this relationship, TOPGUN should institute some training in their core curriculum on the Test and Evaluation (T&E) process.

Advantages

There are numerous advantages of an integrated squadron concept. There are also some drawbacks associated with the concept, but those could be minimized through support from other commands. To evaluate the utility of the concept, the problems with the existing structure would be analyzed.

Cost and Schedule

Traditionally the cost and schedule of the operational evaluation of any program is minimal to the overall cost and schedule of the development. Table 3 shows a list of recently completed Air Force acquisition programs and the cost of development.

Table 3. Air Force OT&E Cost Data

Program	Acquisition Cost	OT&E Cost	% OT&E
Joint Direct Attack Munition (JDAM) (Mk-84)	2,386 M	2.0 M	0.085%
Joint Helmet Mounted Cueing System (JHMCS)	569 M	1.0 M	0.179%
B-1 Conventional Mission Upgrade Program (CMUP) D	669M	0.9 M	0.148%
B-1 Conventional Mission Upgrade Program (CMUP) E	840 M	0.3 M	0.041%
Cheyenne Mountain Upgrade	1,800 M	2.1 M	0.118%
APG-63 Radar Upgrade	1,000 M	1.6 M	0.160%
Wind Corrected Munitions Dispenser (WCMD)	650 M	1.2 M	0.186%
Joint Stand-Off Weapon (JSOW)	6,000 M	2.2 M	0.036%
Total	**7,915 M**	**9.34 M**	**0.118%**

Source: Christie, Thomas P., "T&E Transformation" *International Test & Evaluation Summit & Exhibition*, March 2003: 9.

As shown in the table, the cost of OT&E was less than 0.2% of the total program cost. Therefore, just by integrating the squadrons a huge savings will not be apparent in total program cost. The near term objective should not be just about reducing cost, but to reduce waste, therefore allowing for more productive use of the same funding.[33] In the long term, this will drive down cost. Similarly, the time savings of just integrating will not be very apparent. Table 4 shows a comparison of recent aircraft and weapons acquisition programs.

Table 4. Major System Test Time Comparison

System	Development Time	Planned Length of IOT&E
F-22	22 years	6 months
V-22	20 years	7 months
Joint Strike Fighter (JSF)	15 years (Planned)	-
AIM-9X	5 years	6 months

Source: Christie, Thomas P., "T&E Transformation" *International Test & Evaluation Summit & Exhibition*, March 2003: 11.

As shown, OT&E is a relatively short period in the overall development of the program. Typical delays in OT are on the order of months, which is small in comparison to the longer running development of programs. In both cases it is shown that you do not save time or money by cutting tests. However, in a recent study conducted by COTF, preliminary calculations showed that by instituting just some of the solutions mentioned here, a 15 percent reduction in T&E time could be achieved.[34] In a program length of 20 years this equates to 3 years.

The key cost saver in integrating the squadrons would be the elimination of the overhead associated with another squadron. While some of the infrastructure would be added elsewhere for support, the increase in efficiency and elimination of duplication of tests will shorten program deployment times by months rather than years.

The cost savings assumes it would not be more expensive to farm-out operational evaluation to returning Fleet units. Table 5 shows a cost breakdown of the cost per flight hour to operate an F/A-18E/F Super Hornet.

Table 5. F/A-18F Cost Comparison Data

($ per Flight Hour)

Squadron	Fixed Cost	AVDLR (1)	Maintenance/Parts
VX-9[35]	3161.95	3582.13	1544.97
VX-31[36]	3236	2570	4544
Fleet F/A-18F[37]	3115.76	2682.53	1070.26

Note 1- Aviation Depot Level Repairable

Source: Created by author. Information extracted from flight hour analysis reports.

The fixed cost to operate in any squadron is roughly the same across the board. The table highlights differences in two areas: AVDLR and Maintenance/Parts. VX-31 is unique in that its AVDLR costs are so low due to the way in which aircraft are maintained. Each aircraft is a specialized aircraft and not of a Fleet representative configuration. Therefore, most maintenance is done on site and not sent to a depot. Additionally, maintenance/parts are so high for VX-31 is for two reasons: specialized one-of-a-kind parts and contract maintenance. What is not reflected in this high number is the personnel cost savings generated by shifting from a military maintenance force to contract personnel which skews this number heavily. Integrating to a VX-31 structure for the integrated squadron would not change the numbers significantly. Cost savings would be seen in the reduction in number of aircraft and using the lower cost Fleet aircraft to perform the majority of testing. Additionally, the greatest cost savings will be in eliminating institutional and overhead costs as those are funded outside of acquisition program budgets.[38]

Communication

Probably the largest source of problems within the current structure is the communication problem. The two separate chains of command are barriers that stove-

pipe information and become obstacles to rational and efficient decision making. Cooperation is more effective than confrontation. The singular structure fixes this enormous problem. By integrating everyone under one chain of command and working side by side on a daily basis, the barriers are lifted. While there may still be internal strife between the developmental and operational sides of the integrated squadron, there is a means by which to solve these issues through the CTP, OTD, and their higher entities within the acquisition process. In the increased complexity of future programs, OT&E's early and continuous involvement will be critical,[39] and effective communication will be essential to program efficiency and success. This solution achieves that goal.

Personnel

Both squadrons currently are staffed well below the required levels. The idea of "do more with less" has become a mainstay in the military community. While these staffing problems have been evident for some time the programs still get completed. The integration of the two squadrons will by no means fix the staffing issues currently plaguing the Navy as a whole. It will, however help towards achieving a more manageable solution. Sharing manpower between contractor, developmental, and operational testers would help address the resource shortfalls.[40] Simply combining the two squadrons together with the same amount of total aircrew is not the answer either. This would suffer severely in efficiency of test conduct and operation. An in-depth analysis of the optimal squadron staffing is required.

Test Structure

The proposed solution for conducting the operational evaluation is not a new one. Having Fleet squadrons conduct the evaluation has been done for some time. However, improvements to the practice could yield huge dividends to both the test community and the Fleet. Allowing the Fleet evaluation squadrons, TOPGUN, and the operational testers to get the items under test sooner than would normally be achieved, would benefit the entire system. The test community benefits from the increased sorties, hours, and "eyes on" any given system under test. The Fleet benefits through the ability of TOPGUN to have tactics ready upon Fleet release and deployment, and through the satisfaction of having a voice in the process of development. The structure of the integrated squadron also helps in cutting down the redundancy of test as all members, both developmental and operational, have input from the start of a program.

Summary

Chapter Four outlined a possible solution to the problems noted in Chapter Two. This solution is but one of many possible solutions available to combine the DT&E and OT&E test squadrons at China Lake, California. This study has examined the historical relationships between the two squadrons, the legacy of acquisition reform, the current test structure and its problems, and a possible solution on how to fix them. However, a more in-depth study is needed.

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CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

Review

The preceding chapters have outlined the history, problems, reform efforts, and a proposed solution for solving the problems associated with the relationship between the naval strike fighter DT&E and OT&E communities. The following is a brief synopsis of the research.

Chapter One began the discussion with a brief history of the acquisition reform efforts, particularly efforts within the past 50 years. The problems associated with legislative and budgetary control by Congress and the pure size of the acquisition system were also detailed. The issues of acquisition program cost, schedule, communication, and personnel were introduced. The discussion culminated with the primary thesis of the paper: to determine how the relationship between the developmental and operational aircraft testing can be changed to better align to the realities of cost and schedule in the current testing environment.

The literature review in Chapter Two examined the body of works available on the subject. A brief history of the DT&E and OT&E squadrons involved, as well as the current test structure was discussed. The subject of transformation was introduced and the reasons why reform was necessary and the resistance to that reform were debated. The problem areas noted in Chapter One, cost, schedule, communication, and personnel, were expanded on and the problems with these areas within the current system were analyzed. Finally, a few attempts by the Navy and Air Force at fixing the issues identified previously were analyzed.

Chapter Three discussed the methodology used to analyze the primary research question. Research consisted of an historical examination, current acquisition process analysis, and then an analysis of the problems identified through that research. To arrive at a final solution the problem areas identified in Chapter One were analyzed.

Finally, Chapter Four provided analysis and comparison of the three options available to reform the current system: do nothing, eliminate the OT&E squadron, or combine the DT&E and OT&E squadrons into one entity. The problem areas identified in Chapter 1 were used to compare the alternatives. The solution of combining DT&E and OT&E into a single entity was then expanded to answer the primary research question of determining how the relationship between DT&E and OT&E could be changed to better align to the realities of the current testing environment.

Conclusion

> "Our Bottom line is…field a superior capability, affordably and in less time than our potential adversaries." -Honorable Paul G. Kaminski, Under Secretary of Defense for Acquisition and Technology.[1]

This paper has presented a solution of combining the DT&E and OT&E squadrons located at China Lake, California to solve the problems of cost, schedule, communication, personnel, and test conduct related to the current structure. Through eliminating the current OT&E squadron, and placing some of their assets into the DT&E squadron to assume the operational evaluation mission, it was shown that a substantial increase in efficiency could be gained. Determining the exact value in time and money is well beyond the scope of this investigation and would require additional focused

research. The concept of combining DT&E and OT&E into a singular entity was shown to be valid and elaborated more on ideas presented in previous studies.[2]

The study concluded that a combined squadron would require some reorganization due to the assumption of the operational evaluation role. An addition of 15 aircrew, 60 maintainers, and six aircraft to the current DT&E squadron were presented as a starting point for reorganization. These additions, with the elimination of the OT&E squadron, represent a reduction of 52% for aircrew, 76% for maintainers, and 60% for aircraft. In maintenance personnel alone the savings would be over 16.2 million dollars per year. Further research is required to determine the optimal numbers to add to DT&E to assume the operational evaluation role. Once that is determined, additional research could be done to conclude the savings that would be generated.

Well trained test personnel are required to accomplish test programs efficiently.[3] This study concluded that combining DT&E with OT&E would require minor changes in how aircrew and engineers are trained. The solution presented was to model the Air Force OT&E training program at USAFTPS and create a “short course” of instruction at USNTPS. The “short course” would be targeted at those aircrew and engineers that do not attend the longer test pilot course of instruction. This collocation of training would have the added benefit of combining DT&E and OT&E training at a single source. Additionally, the paper concluded that T&E training be included in the TOPGUN curriculum.

The change to the way in which OT&E testing is conducted is the most far reaching aspect of this paper. This paper concluded that by using Fleet assets to conduct a vast majority of the OT&E portion of test, it would allow for the drastic reduction in

personnel and overhead associated with the combination of the DT&E and OT&E squadrons. Through providing support, expertise, and planning to Fleet assets, the operational evaluation could be conducted in less time and would provide valuable input to product development and expand Fleet system knowledge. This effort would require the support of Fleet units and TOPGUN in order to work effectively. Further study is required to determine the actual test conduct and timeline using this model.

The solutions presented go a long way in solving the problems of cost, schedule, communication, personnel, and test conduct. This study only scratches the surface of what could be achieved. With further study a viable working solution could be developed.

Today's acquisition reforms continue the trends of the last 230 years. What is needed is a drastic change to the existing structure to spur development and innovation. The ideas expressed in this paper only touch the surface of what could be accomplished through integration of the developmental and operational test squadrons. The solution presented is a step towards achieving the Chief of Naval Operations' (CNO) goal of reducing T&E cost by 20%.[4] Experience in acquisition reform has shown there will be no quick fixes and there will be many obstacles to accomplishing institutional change. The greatest problem for implementing this idea is to overcome the paradigms present in the two test communities. Institutions have a vested interest in maintaining the system as it is, and true change must be mandated by senior management.[5] Change must occur via a strong proponent and leader from the top, and buy-in must be attained from all levels of leadership on down. No matter which T&E organization is involved, partnerships with others is the key to that organization's future relevance.[6] If these changes occur the Navy

will have an efficient, well functioning test organization that produces a far superior product to Fleet aviators in less time and at a greatly reduced cost. However, before any meaningful work towards this implementation can be done, further in-depth study is required to determine the actual cost effectiveness of this approach. The following recommendations are made for the implementation of this solution.

Recommendations

- The numbers presented in this document are purely an observational solution. An in-depth study should be undertaken in the following areas:
    - The cost savings that could be achieved by combining the two squadrons.
    - A comprehensive manpower survey on what the optimal staffing of the proposed squadron would entail.
    - A usage analysis to determine the optimal aircraft numbers and types to be added to VX-31 to operate in the operational evaluation role.
    - USNTPS in conjunction with COTF and the USAFTPS develop a "short course" for training operational evaluators and integrate portions of that course into the core USNTPS curriculum.
    - TOPGUN implement a class into their course of study on T&E aspects.

[1] Kaminski, Paul G. "Reinventing DoD Test & Evaluation." *International Test and Evaluation Association Symposium.* Hunstville, Alabama. 3 October 1995.

[2] Commander, Operational Test & Evaluation Force. *COMOPTEVFOR Report for Streamlining Navy T&E Processes: CNO Guidance for 2004 Task 73*. Norfolk, Virginia. July 2005: 4, 10.

[3] Erno, JoAnn L. Maj USAF. “Air Force Development Test and Evaluation Under Acquisition Reform: Six Flight Test Process Concepts.” Air Command and Staff College, Maxwell AFB, Alabama. April 1998: vi.

[4] Commander, Operational Test & Evaluation Force. *COMOPTEVFOR Report for Streamlining Navy T&E Processes: CNO Guidance for 2004 Task 73*: 2.

[5] Frank, Dr Deborah F. "A Theoretical Consideration of Acquisition Reform." *Acquisition Review Quarterly.* (Summer 1997): 283.

[6] Simmons, Brian M. "Imperatives for T&E Change Must Come From Within." *ITEA Journal of Test and Evaluation.* (June/July 2006): 9.

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